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Policy Options for Ethiopia's Coffee Exports

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Abstract

This paper addresses pricing and production options for Ethiopia's coffee exports. We develop a model of constrained optimization based on the current International Coffee Agreement structure, own-price import demand elasticities, and derive price discriminating functions to optimize export revenues. While there are some non-quota markets such as Saudi Arabia and South Korea, we find greater revenue opportunities through a re-allocation of exports away from the U.S. market to West Germany, Japan, and Italy.

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Introduction

As recent national census data have shown, agriculture in Ethiopia accounts for more thon 50 percent of the total gross domestic product and employs more thon 92 percent of the total population. Agricultural products comprise the predominant part of the country's total exports, with coffee accounting for more thon 60 percent of the total export value, as con be seen in Table 1. Other major export commodities include hides and skins, oil seeds, end fruits and vegetables. As coffee is the most important item in the export market of Ethiopia and is the main source of export earnings and as Ethiopia is also the leading coffee consumer among all African coffee producers, how coffee marketing decisions are mode con have important consequences for the national economy.

Table 1
Major Export Items of Ethiopia, 1980-82

	Exports (U.S., $ millions)			Percentage of Total Exports by Value		
Commodity	1980	1981	1982	1980	1981	1982
Coffee	274.10	228.60	249.60	64.50	60.50	61.70
Hides/Skip	52.20	47.50	41.20	12.30	12.60	10.20
Fruits/Veg	14.80	15.40	20.10	3.50	4.10	5.10
Oil Seeds	7.50	14.10	12.10	1.80	3.40	3.10
Total:	348.60	305.60	323.00	82.10	80.60	80.10

Source: The World Bank, *Commodity Trade and Price Trade Annual*, 1983

In the sections that follow, Ethiopia's coffee markets are analyzed in terms of an underlying economic modal, along with a discussion of alternative marketing strategies. The approach used here has been to determine the demand characteristics of Ethiopian coffee in both quota and non-quota markets and to estimate revenue maximizing allocation of coffee exports among different markets.

Export Markets for Ethiopian Coffee

World coffee export markets are shaped by a variety of factors. One worth noting is the shift toward instant coffee among the major consuming countries over the post thirty years, and which has affected both the level of per capita consumption as watt as the market potential of coffee producers. Non-instant, or percolated coffee, relies largely on arabica coffee beans, while robusta beans are more important to instant coffee products. Because Ethiopia has traditionally been a producer of arabica coffee, such shifts in world coffee market demand take on added significance.

For international markets, arabica coffee is classified in terms of washed, or mild, and unwashed. This distinction depends on how coffee is processed after harvesting. Coffee cherry that la dried and depulped to remove the coffee bean is classified as unwashed. When cherries are depulped immediately and the beans are placed in water, such coffee is classified as washed**.** Ethiopia exports mostly unwashed coffee beans.

Almost half of Ethiopia's annual coffee production is consumed domestically. In addition to the marketing pattern shown in Table 2, estimates by the U.S. Department of Agriculture indicate that for the 1982/83 and 1982/84 production years, annuel domestic consumption was 48.6 and 49.2 percent of annual production respectively. Recent trends in the export of Ethiopian coffee have been a cause of major concern. Ethiopia's annual coffee exports declined et a rate of 0.63 percent per year during 1970-80, as con also be seen in Table 2.

Table 2

Ethiopia's Coffee Production and Export Markets

Years	Production in million Kg.	Exports, in million bags.	Years	Annual Growth Rates	
				Production	Exports
1960-62	0.01	1.04	1961-76	1.47	-1.11
1970-71	2.59	1.33	1961-80	2.08	-0.15
1976-77	2.79	0.72	1961-70	2.46	2.35
1978-79	3.14	1.38	1970-80	3.20	-0.63
1979-80	3.09	1.31			
1980-81	3.11	1.21			
1981-82	3.61	1.28			

Source: U.S.D.A., *Foreign Agriculture Circular, Coffee*, Washington, D.C., 1981-82.

Table 3

Exports of Ethiopia's Green Coffee Beans to Selected Countries under International Coffee Organization Market Quotas

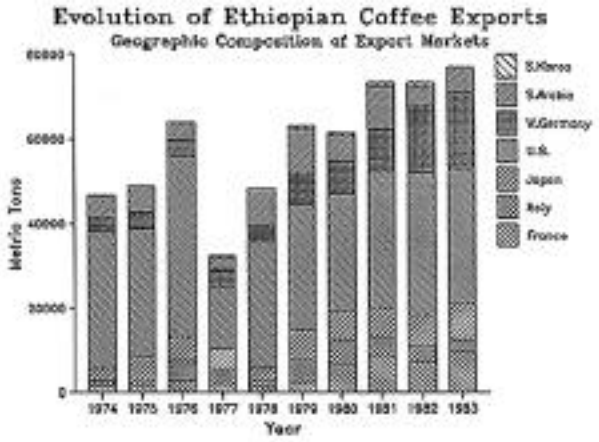
Country	1978-79	1980-81	1981-82	1982-83
United States	47.20	44.90	46.20	39.20
W. Germany	11.60	14.00	21.30	22.70
Japan	10.50	9.80	9.80	10.60
France	4.20	12.00	10.10	11.60
Italy	8.50	6.10	4.60	6.00
All Other	18.00	13.20	8.00	9.90
Total	100.00	100.00	100.00	100.00

Source: Ministry of Coffee and Tea Development. *Coffee Statistics Handbook 1960-61-1982-83.* Addis Ababa, Ethiopia, September 1984.

As a member of the International Coffee Organization, or ICO, Ethiopia's marketing strategies turn on the setting of its export quota and on its capacity to export coffee to non-member countries in the ICO. Two major factors which have adversely affected coffee deliveries for export markets have been the absence of price incentives to farmers and adverse weather conditions, particularly the periodic droughts of the post several years.

As to pricing incentives, based on data from the Ethiopian Ministry of Coffee and Tea Development, Ethiopian producers recently received the equivalent of U.S.$0.48/kg. white their production costs may have been as high as U.S. 50.57/kg.,thereby discouraging production. Moreover, prices paid to producers by state trading authorities and service cooperatives were low in comparison to prevailing world market prices. As Teshome Mulat demonstrated in a study of coffee pricing behavior, Ethiopian coffee export prices and producers' prices have been closely correlated.[1] Thus, an increase in export earnings con motivate farmers to expand marketed production. Under the conditions where both producers and exporters obtain economic profit from exports, Ethiopia could also increae export earnings by re-allocating coffee production among different markets.

Figure 1



Demand Estimates for Ethiopian Coffee

Countries that import coffee from ICO member exporters are categorized in the quota market, while others are included in the non-quota market. Demand characteristics for Ethiopian coffee in these two types of markets may be different. Among all importing countries, five can be considered major importers under the quota market on the basis of

[1] Mulat, Teshome, "Coffee Producers' Income Share", *Ethiopian Journal of Development Research*, Addis Ababa vol. 3(1), April 1979, pp. 51-68.

annual import of green coffee from Ethiopia, namely, the United States, West Germany, Japan, France, and Italy. The importance of these countries to Ethiopia's coffee export markets is profiled in Table 3.

The "all other" category of Table 3 represents Ethiopia's green coffee exports to non-quota markets. Within this category, Ethiopia has exported over the years between 30 to 80 percent of its residual green coffee beans to Saudi Arabia. The other major country in the non-quota market has been South Korea.

Global annual per capita coffee consumption varies considerably among countries. For instance, in a 1983 World Bank report, annual coffee consumption was reported as 26 pounds per capita in the Scandinavian countries, 18 pounds in the Benelux countries, and 13 pounds in the U.S., while consumer in Brazil, the Federal Republic of Germany, and France consumed about 11 pounds per capita each.

Western Europe, especially the European Economic Community, has increased its coffee imports steadily for the lest 20 years. As shown in the World bank study, even during 1970-79, when the volume of world imports increased by only 0.6 percent annually, the community's net coffee imports grew et the rate 1.9 percent per year. However, studies by the ICO indicated that growth in per capita coffee consumption in the U.K., U.S., and West Germany has been slowing down, white fruit juice and soft drink consumption has been increasing et a rapid rate.[2]

Japan, the centrally planned economies of Eastern Europe, and the U.S.S.R. have also had considerable increases in consumption (ICO). As to trends in the world market for coffee, econometric models have projected demand increases at annual rates of around 1.3 percent through the early 1990's. These models have also taken stock of a near virtual stagnation in word production through 1987, with some projected growth in production thereafter.

Most studies of coffee demand are based on estimates of price and income elasticities, from which consumption forecasts are derived. Abaelu and Manderscheid's 1968 study of U.S. import demand functions for different coffee varieties including mild, brazils, and

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[2] International Coffee Organization (ICO), "Coffee in the Federal Republic of Germany", (London, U.K.: October 1979); "Coffee in the United Kingdom", (London, U.K.: March 1980).

robustas provides a useful benchmark for more recent work as well as the present study.[3] They estimated the corresponding income elasticities as 0.39, 0.89, and 1.82.

In a more recent study by Singh *et. al*., income elasticities of demand for coffee for both the U.S. and other importing countries were assumed to decline with increasing income.[4] Their projected price and income elasticities of demand for 1985 were -0.212 end 0.001 for the U.S., and -0.262 and 0.536 for other importing countries. On the other hand, the price and income elasticities for the producing (net exporting) countries were projected by the authors at 0.888 and 0.777, respectively.

Methodology

Ordinarily, estimating the dynamics of Ethiopia's coffee markets would combine information on both demand and supply. Unfortunately, the annual coffee supply could not be estimated because reliable data for Ethiopian coffee acreage, domestic consumption, and stocks were not available. However, the average of the total exportable production, which was reported as coffee arrival at the central markets of Addis Ababa and Dire Dawa, was taken as a predetermined supply for distribution among the countries under the quota and non-quota markets, and has been used in the estimation of demand for Ethiopian coffee.

Ethiopia's total annual exportable production was considered as a given amount, and was allocated econometrically among the major importing countries. Total export revenue equations for Ethiopia were obtained from import demand equations. In turn, export marginal revenue, or MR, functions for each country were derived so as to equate the marginal revenues for maximizing the total export revenue. A review of the application of this method in agriculture based on the principles of price discrimination is presented in Waugh, and Bressler and King.[5]

Time series date for coffee imports for quota and non-quota markets were obtained primarily from the Ministry of Coffee and Tea Development. Import prices of coffee measured in U.S. dollars per ton were obtained from Trade Yearbooks published by the

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[3] Abaelu, J.N. and L.V. Manderscheid, "US. Import Demand for Green Coffee by Variety", *American Journal of Agricultural Economics*, 50 (1968), pp. 232-242.

[4] Singh, Shamsher, Veries de Jos, J.C. Hulley, and Patrick Yeung, *Coffee, Tea and Cocoa: Market Prospects and Development* (Washington, D.C.: The World Bank, 1977).

[5] Waugh, Frederick, Demand and Price Analysis, Technical Bulletin No. 1316 (Washington, D.C.: U.S. Department of Agriculture, 1964); Bressler, Raymond G. And Richard A. King, *Markets, Prices, and International Trade* (New York: John Wiley and Sons, Inc., 1970).

Food and Agriculture Organization (FAO). Indices for real gross domestic product measured in U.S. million dollars (1974=100) were obtained from International Financial Statistics Supplement on output Statistics (IMF). Exchange rates of each country were obtained from international. Financial Statistics Yearbook (IMF).

Since one importing country is assumed to be a residual of the others in the export market, error terms of the import demand functions were expected to be correlated across equations. Zellner has suggested that when error terms of two or more separate equations are correlated, a seemingly unrelated regression (SUR) modal is appropriate.[6] Based on a SUR model specification, regression coefficients of all equations were estimated simultaneously by applying Aitken's generalized least squares to the system of equations.[7]

In specifying the import demand models, two types of prices were utilized for different countries. Either import prices (IPC) or relative import price (IPR) were used in the coffee import demand equations. These prices were assumed to be dependent on the quantities demanded, that is, coffee imports from Ethiopia (CIE).

Werner and Kreinin, along with Bahmani-Oskooee, have emphasized the importance of exchange rate fluctuations in determining international trading patterns.[8] Since exchange rates of coffee importing countries were floating rates, fluctuations in these rates undoubtedly affect the volume of coffee imported by each country, and exchange rates (EX) were included in the import demand equations.

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[6] Zellner, Arnold., “An Efficient Method of Estimating Seemingly Unrelated Regression”, *Journal of the American Statistical Association*, 57 (1962), pp. 348-368.

[7] Aitken, A.C., “On Least Squares and Linear Combinations of Observations”, *Proceedings of the Royal Statistical Society of Edinburgh*, vol. 55 (1935), pp. 42-48.

[8] Warner, Dennis and Mordechai E. Kreinin, “Determinants of International Trade Flows”, *Review of Economics and Statistics*, (February 1981), pp. 96-104; Bahmani-Oskoee, Mohsen, “Determinants of International Trade Flows: The Case of Developing Countries”, *Journal of Development Economics* 20 (1986), pp. 107-123.

The import demend equations used in this study were expressed as follows:

IPC_i, or $IPR_i = f(CIE_i, GDP_i, Ex_i, U_i)$,

where: CIE = the quantity of coffee imported from Ethiopia by the corresponding countries, in metric tons;

IPC_i = imports of coffee, in $US. Dollars per tonne

IPR_i = the relative import price, defined as imports divided by the world price of coffee, (IPC/WPC);

GDP_i = Gross Domestic Product of the corresponding countries (1974=100)

Ex_i = Exchange rate of country i (1974=100)

U_i = error term, and

i = 1,2,3,4, and 5, for W. Germany, U.S.A., Italy, Japan, and France, respectively.

Estimated Import Demand Functions

Import demand relations for Ethiopian coffee for the five major importing countries in the quota market were estimated as a Seemingly Unrelated Regression model on the basis of data for 1974-1983. The variables are expressed in common logarithm values. Numbers in parentheses are student t-values. The signs of the regression coefficients in each of the five equations were consistent with the hypothesized relations. Except for one variable, t-values were significant et $p < .10$. The coefficients for exchange rates were not statistically significant except in the equation for France, and hence, this variable was excluded from all equations except for France. Overall, the specified variables appeared to be appropriate for each of the equations.

Since the import-demand functions for each country were estimated in the double log form, price and income elasticities, as presented in Table 4, were obtained directly from the equations. The estimated income elasticities seemed to support the earlier findings of Abaelu and Merderscheid that mild coffee is an economic normal good. Income elasticities for the U.S. and West Germany were considerably higher than those for other countries. The demand for Ethiopian coffee in the selected countries was relatively price elastic, indicating that increasing exportable coffee production would increase the total export earnings. The price elasticities for France and the U.S.A. were substantially different from the others. Different price elasticities of demand for different markets may

suggest the possibility of reallocation of coffee among those markets to maximize export earnings for Ethiopia.

France:

$$\text{Log (IPR)} = -3.537 - \underset{(-3.65)}{0.347} \log (\text{CIE}) + \underset{(2.07)}{0.647} \log (\text{EX}) + \underset{(3.07)}{0.645} \log (\text{GDP})$$

Italy:

$$\text{Log (IPR)} = -0.777 - \underset{(-5.30)}{0.269} \log (\text{CIE}) + \underset{(3.64)}{0.531} \log (\text{GDP})$$

Japan:

$$\text{Log (IPR)} = 0.847 - \underset{(-2.71)}{0.265} \text{Log (CIE)} + \underset{(2.04)}{0.239} \text{Log (GDP)}$$

U.S.A.:

$$\text{Log (IPR)} = 7.213 - \underset{(-3.79)}{0.697} \text{Log (CIE)} + \underset{(3.08)}{1.049} \text{Log (GDP)}$$

West Germany:

$$\text{Log (IPC)} = 0.077 - \underset{(-1.26)}{0.270} \text{Log (CIE)} + \underset{(3.08)}{1.491} \text{Log (GDP)}$$

Weighted R^2 for the System = 0.75
Weighted Mean Square Error for the System = 1.38

Unlike the equations for the quota market, estimates of import demand equations for the non-quota market produced inconsistent signs of coefficients and inadequate statistical results. On average**,** Saudi Arabia imported about 48 percent of its total coffee from Ethiopia. However, data for Saudi Arabia did not yield acceptable results for the demand relationship. In the case of South Korea, average coffee imported from Ethiopia was only 6 percent of its total coffee imports, and the specified modal did not yield a satisfactory demand relationship. White there appears to be an established pattern of coffee consumption in the ICO-member countries, coffee consumption in the selected non-ICO member countries were unstable. Import demand functions for non-ICO countries were, therefore, excluded from the study.

Allocation of Total Coffee Exports Among Markets

As discussed earlier, for three demand functions (France, Italy, and Japan), relative import prices (IPR) were utilized as the dependent variables. To solve for the "optimum" allocation of coffee among the major importing countries, the IPR relationships were

transformed into price (IPC) relationships as presented in Table 5. The marginal revenue equation for each country was derived from the total revenue equation based on the IPC equation, and is shown in Table 6.

The "optimum' allocation of coffee beans among major importing countries under the quota market was obtained by equating the marginal revenues of each country. The "optimum' distribution of the predetermined quantity of 72,909 metric tons of exportable coffee beans among the 5 major importing countries was solved for the selected year 1983. The resulting quantities and prices are presented in Table 7.

Comparisons were also made between the "optimum" solution and the actual coffee distributions of 1983, as shown in Table 8. The normative solution from the mode (showed that a reallocation of coffee exports to the countries under the quota market could significantly affect Ethiopia's export earnings. Under the "optimum" solution, West Germany would become the major importer of Ethiopian coffee, buying 29 percent of the total exported coffee. Next, the U.S. and Japan would each import about 23 percent of Ethiopia's total coffee exports, white France and Italy would import 14 and 11 percent, respectively.

The actual distribution indicated that the U.S. was the major importer of Ethiopian coffee in 1983, importing about 44 percent of Ethiopia's total exported coffee. Under the "optimal" simulation, the quantity of coffee to be exported to the U.S. would decrease substantially from the actual level of 31.9 thousand metric metric tons to 16.5 thousand metric tons, as shown in Table 8. Consequently, the U.S. price would increase from 201.0 to 322.5 U.S. cents per kg. On the other hand, the "optimum" quantities of coffee that would be exported to Japan would be doubled compared to the actual quantity, and the volume of exports to Italy would increase from 4.8 thousand metric tons in actual distribution to 8.1 thousand metric tons in the "optimum" solution. However, the "optimum" distribution of coffee to France did not reveal any significant difference relative to the actual quantity.

Total export revenues were computed for both actual and "optimum" distributions. As shown in Table 8, Ethiopia's actual export earnings for 1983 stood at $126.04 million. However, using expanding exports in markets where price elasticities are higher and reducing them where they are lower results in an increase in total export earnings to $130.36 million, en increase of over three percent.

Table 5

Import Demand Functions for Ethiopian Coffee, 1974-1983

France	$IPC= 3665.74 * CIE1^{-.347}$
Italy	$IPC=1511.07 * CIE2^{-.269}$
Japan	$IPC= 1762.37 * CIE3^{-.265}$
United States	$IPC=280,858 * CIE4^{-.697}$
West Germany	$IPC=1979.59 * CIE\ 5^{-.270}$

As shown, the optimum distribution of coffee would imply a quantity substantially less thon the actual volume for the U.S. market. This may be due to the fact that the optimum solutions May be outside the scope or the range of the data. Realistically, however, it may not be possible to implement such a drastic reduction in coffee exports to the U.S. and to consider such a steep increase in prices. Since Ethiopia imports most of its agricultural inputs and machinery mainly from the U.S., the traditional trade relationships with the U.S. could be a major consideration of the policy makers. Therefore, as alternatives to the "optimum" solutions, three feasible solutions were developed as presented in Table 8. These feasible solutions were obtained by increasing the optimum quantities of coffee that would be exported to the U.S. by 20, 35, and 45 percent and by decreasing the optimum quantities of coffee that would be exported to Japan and Italy by 10 and 20 percent, respectively.

The first feasible solution of Table 8 was obtained by increasing the optimum quantity of coffee exports to the U.S. by 20 percent and decreasing exports to Japan and Italy by 10 percent each. As a result, the U.S. import price of coffee would decline from 322.5 to 284.0 cents/kg. and the total export revenue would be !130.11 million, which would be slightly less thon the hypothetical maximum. The second feasible solution in columns was developed by increasing the optimum quantity of coffee exports to the U.S by 35 percent and reducing the optimum quantity of coffee exports to Japan and Italy by 20 percent each. Consequently, the import price of U.S. would further decline to 261.7 cents/kg. and total export earnings would be $129.63 million. The third feasible solution in Table 8 was obtained by raising the optimum, quantity of exports to the U.S. by 45 percent and by towering the optimum quantity of coffee exports to Japan, Italy, and France by 20, 20, and 16.4 percent, respectively. The import price in the U.S. for the solution would further decline to 248.9 cents/kg. The resulting total export revenue from

these allocations was lower thon that of feasible solutions 1 and 2, but was higher thon that obtained from the actual distribution.

Table 6
Export Total and Marginal Revenue Functions for Ethiopian Coffee Markets

France:	TRF	=	$3665.74 \cdot CIE1^{.653}$
	MRF	=	$2393.73 * CIE1^{-.347}$
Italy:	TRI	=	$1511.07 * CIE2^{.731}$
	MRI	=	$1104.59 * CIE2^{-.269}$
Japan:	TRJ	=	$1762.37 * CIE3^{.735}$
	MRJ	=	$1295.34 * CIE3^{-.265}$
United States:	TRU	=	$280{,}858.46 * CIE4^{.303}$
	MRU	=	$85{,}100.0 * CIE4^{-.697}$
West Germany:	TRG	=	$1976.59 * CIE5^{.730}$
	MRG	=	$1445.10 * CIES^{-.270}$

Source: Derived from the demand equations of Table 5

Table 7
Optimal Allocation of Coffee Among Major Importing Countries, 1983

	Quantity, in metric tons	Price, $U.S./lb.	Percent of total exports
France	10,043.40	$1.4980	13.80
Italy	8,139.80	$1.3407	11.16
Japan	16,970.20	$1.3342	23.26
United States	16,518.20	$3.2253	22.66
W. Germany	21,237.70	$1.3415	29.12
Total	72,909.30		100.00

Estimates for coffee export allocations were also mode for 1983 under two alternative assumptions. It was assumed that the International Coffee Agreement (ICA) would increase or decrease the quota for Ethiopian coffee to the member countries by 10 percent above or below the actual 1983 level. Accordingly, solutions for coffee export

distributions for 1983 were developed under these assumptions to maximize export earnings by equating the marginal revenues, as Io shown in Table 9.

When the total quantity of coffee export to the quota market was assumed to increase by 10 percent in 1983, the volume of coffee exports to Japan would increase from the 1983 actual and the optimum levels of 8,485 and 16,970 metric tons, respectively, to 19,310 metric tons. As a result, Japan would be the major importer of Ethiopian coffee next to West Germany. quantities of coffee exports to the U.S. would decrease from actual level of 31,877 metric tons. As the total quantity of coffee export increased by 10 percent, the total export revenue would also increase by 9.6 percent compared to the actual export earnings of 1983.

On the other hand, when the total quantity of coffee exports to the quota market was assumed to decrease by 10 percent, the total export earnings declined by only 2.2 percent compared to the actual export earnings of 1983. Under this alternative assumption, the quantity of coffee exports to the U.S. would have declined from the actual and optimum, levels of 31,877 and 16,518 metric tons, respectively, in 1983 to 15,726 metric tons.

Similar analysis could be performed to evaluate the allocation of specified total coffee export quantities for other selected years. It is conceivable that some solutions of the model could produce feasible allocations resulting in total export earnings substantially higher than the revenues which may be generated otherwise.

Table 8
Alternative Coffee Distributions for Ethiopia
Under the Quota Market, 1983

Actual Distribution:	W.Germany	United States	France	Japan	Italy	Total
Volume, tonnes	18,239.00	31,877.00	9,522.00	8,485.00	4,786.00	72,909.00
Price/kg,U.S.cents	139.78	203.97	152.59	160.33	154.66	
Total Export Earnings (in $U.S. Millions)	$25.49	$65.02	$14.53	$13.60	$7.40	$126.04
Hypothetical Distribution:						
Volume, tonnes	21,237.70	16,518.20	10,043.40	16,970.20	8,139.80	72,909.30
Price/kg,U.S.cents	134.15	322.53	149.8	133.42	134.07	
Total Export Earnings (in $U.S. Millions)	$28.49	$53.20	$15.04	$22.64	$10.91	$130.28
Feasible Solution I						
Volume, tonnes	20,444.80	19,821.80	10,043.40	15,273.20	7325.80 72	65,583.20
Price/kg,U.S.cents	135.54	284.04	149.8	137.2	137.92	
Total Export Earnings (in $U.S. Millions)	$27.71	$56.30	$15.05	$20.95	$10.10	$130.11
Feasible Solution 2						
Volume, tonnes	20,478.00	22,299.60	10,043.40	13,576.20	6,511.80	72,909.00
Price/kg,U.S.cents	135.48	261.65	149.8	141.55	142.36	
Total Export Earnings (in $U.S. Millions)	$27.74	$58.35	$15.05	$19.22	$9.27	$129.63
Feasible Solution 3						
Volume, tonnes	20,478.00	23,951.40	8,391.60	13,576.20	6,511.80	72,909.00
Price/kg,U.S.cents	135.48	248.94	159.44	141.55	142.36	
Total Export Earnings (in $U.S. Millions)	$27.74	$59.62	$13.48	$19.22	$9.27	$129.33

Table 9
Estimated Optimum Allocation of Ethiopian Coffee
Among ICO Member Countries under Alterative Assumptions

	10 Percent Increase in Export Quantity			10 Percent Decrease in Export Quantity		
	Volume, in metric tons	Price per kg. in $U.S. Cents	Total Export Earnings$U.S. Millions	Volume, in tonnes	Price per kg. in $U.S. Cents	Total Export Earnings$U.S. Millions
West Germany	24,109.20	129.80	$31.29	18,709.60	139.50	$26.10
Japan	19,310.30	128.00	$24.72	14,914.80	138.10	$20.60
United States	17,350.20	311.70	$54.08	15,726.40	333.80	$52.90
France	11,085.10	144.70	$16.04	9,100.10	155.00	$14.11
Italy	9,244.90	129.60	$11.98	7,167.30	138.70	$9.94
Total:	81,099.70		$138.11	65,618.20		$123.65

Summary and Conclusions

Ethiopia's coffee exports to quota and non-quota markets account for a major part of the country's total export earnings. Consequently, fluctuations in coffee exports produce substantial impacts on Ethiopia's economy. The main purpose of the study was to analyze the import demand relationships for Ethiopian coffee in different markets. Several countries, including the U.S., West Germany, France, Italy and Japan, are the leading coffee importers in the quota market. Saudi Arabia and South Korea are the major

importers of Ethiopian coffee outside the quota market. Specific objectives of the study were to estimate the demand elasticities or flexibilities for Ethiopian coffee in various markets, and to evaluate the allocation of Ethiopians coffee exports among different markets for increased total export earnings. Seemingly unrelated regression models were estimated to represent the import price of coffee in specified countries as a function of quantity of coffee imported from Ethiopia and the gross domestic product of the country. The results of the models indicated that the demand for Ethiopian coffee in the major ICO member importing countries were relatively price elastic. The price etasticity in the U.S. was considerably less thon those estimated for the other four countries. Income elasticities obtained from models were positive and significant for all importing countries.

The equations representing the demand for Ethiopian coffee in the non-ICO countries (Saudi Arabia and South Korea) did mot appear to be stable or statistically significant. The estimated import-demand functions were used to develop solutions for maximizing Ethiopia's total export earnings by equating marginal revenues for the five countries in the quota market. The “optimum” solution indicated that same reallocation of the given total export quantity among the five importing countries could have increased the total export earnings. However, this "optimum» reallocation produced unacceptly high import prices and low import quantities for the U.S. Subsequently, three feasible solutions were developed to demonstrate alternative allocations of Ethiopia’s coffee exports to the quota market.

Total export earnings obtained from feasible allocations among the five countries were higher thon those derived from the actual distribution. As in the "optimum” results, the feasible solution also indicated a reduced import volume and an increased price for the U.S., and increased imports and lower prices for West Germany, Japan and Italy. Given the price elastic demand for Ethiopian coffee in the selected countries, it may be possible for Ethiopia to increase its total earnings from increased exports to these ICO countries provided that the organization agrees to raise Ethiopia's export quota. As demonstrated in the study, the Ethiopian coffee industry may benefit from a regular analysis of coffee distribution among the ICO countries. Given a predetermined amount of Ethiopia’s total export quota, a reallocation of coffee exports to various importing countries in some instances may produce increased returns to the industry.

Modifications of the pattern of Ethiopian coffee distribution among the major importers may be recommended as shown in the present study. When changes in the total quota are anticipated or known, the suggested models and methods may be useful in

developing a desirable allocation of the total quantity among several countries to increase export revenues. Furthermore, projected optimum or feasible allocations among markets can also be developed for future years under alternative assumptions or scenarios to provide broad guidelines for export distribution policies. Ethiopia's total export quota may not increase substantially since it is a member of the ICO. If the Ethiopian coffee industry tends to raise its exportable coffee production considerably, the potential export markets should be explored in the countries in the non-quota market. Therefore, additional data, information, and research will be needed to study the markets and demand for coffee in these countries outside the ICO.

Data relating to coffee exports to quota and non-quota markets were available only for recent years. Consequently, the short period of fit was a limitation for the estimated equations which may mot have fluty captured the affects of past commercial or trade policies. Furthermore, the absence of reliable data for Ethiopia’s coffee production and domestic consumption prohibited statistical estimation of Ethiopia’s domestic demand for coffee. As a result, the allocation of Ethiopia’s total coffee production between the domestic and export markets could mot be evaluated in the study.

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Appendix A

The econometric modal used in this study is based on the principle of market price discrimination. If markets are discrete and segmentable, then a seller may be able to increase total revenue by engaging in third-degree price discrimination, that is, charging differing prices for comparable quantities to differing consumers, based on underlying differences in the respective own-price elasticities of demand.

Total export earnings from coffee exports consist of receipts whose production are distinct in terms of supply, demand, and market conditions. Changes in world supply, demand, and the interaction of these conditions cause variations in prices which result in fluctuations in export earnings.

Figure 1 represents a one country one-commodity modal, and can be used to illustrate how changes in supply and demand may affect export earnings. In the absence of trade, equilibrium occurs at point M, where domestic demand (Dd) equals domestic supply (Sd). The value of domestic consumption in this case is given by the area OPdMA**.** When trade occurs, total demand, Dt, consists of the summation of Dd and export demand. OC will be sold on the domestic market and CS will be exported. With trade, the value of domestic consumption and exports is given, respectively, by the are OCRPw and CRNB. This results in a higher total revenue.

Substituting one country's coffee for another’s tends to make the importing country's demand for a specific exporting country's product more elastic. As long as product homogeneity holds, importers are indifferent as to the origin of the imported product. in general, agricultural markets experience significant fluctuations in prices and quantities from one time period to another, reflecting weather, commercial policies, plant diseases, and pests, thus leading to significant potential for supplier substitution among markets.

The supply of Ethiopian coffee in export markets is divided into quantities for quota and non-quota markets. Export quotas are set globally by the International Coffee Organization (ICO), i.e., the quantity exported from each individual exporting country. This quota depends partly on the quantity supplied in the previous year from each member country and partly on bargaining considerations.

Demand own-price elasticity coefficients are the key to variations in total revenue. These coefficients, which are the percentage change in quantity exported divided by the

percentage change in price, form the basic for price discriminating strategies designed to augment total revenue.

In Figure 2, total import demand, Dt, is inelastic in the B-D range. Increasing the export quantity in such a market will bring a more thon proportionate decrease in price and a corresponding decrease in total export earnings. This can be verified by comparing the earning area OEBN with the area OFCJ. Similarly, with an elastic demand, total export earnings will increase with an increase in the quantity exported.

Major importers of Ethiopian green coffee from quota markets are the United States, West Germany, Japan, and Italy. In order to exercise price discrimination among these markets, Ethiopia would need to be able to sell its coffee at differential prices. In Figure 3, quantities exported to the U.S. and West Germany are Oqus and Oqwg, respectively. Quantities exported in the non-quota market constitute the residual. Total supply of the non-quota market is OK2 in Figure 4, and is shown as perfectly inelastic, reflecting the time lag in producer cyclers. Determination of the optimal allocation between South Korea and Saudi Arabia under the non-quota market follows the same method used for countries under the quota market. Quantities supplied to South Korea and Saudi Arabia are Oqsk and Oqsa, respectively.

Figure 1
The Effect of Trade on Export Earnings and Consumption in an Exporting Economy

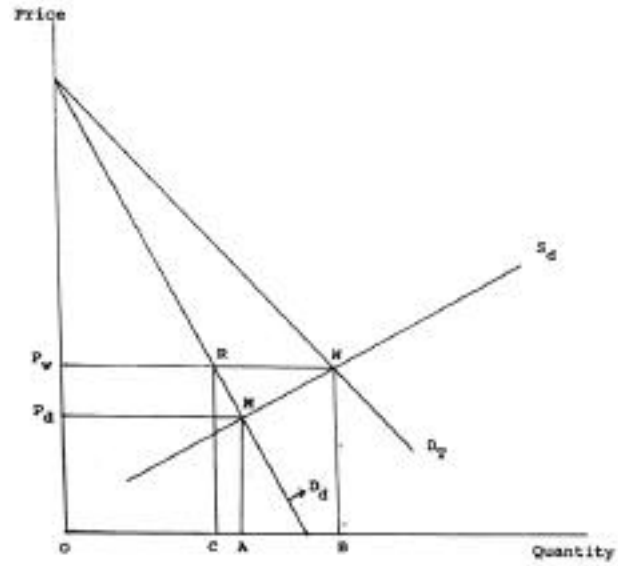


Figure 2
The Relationship Between Total Revenue and The Own-Price Elasticity of Demand

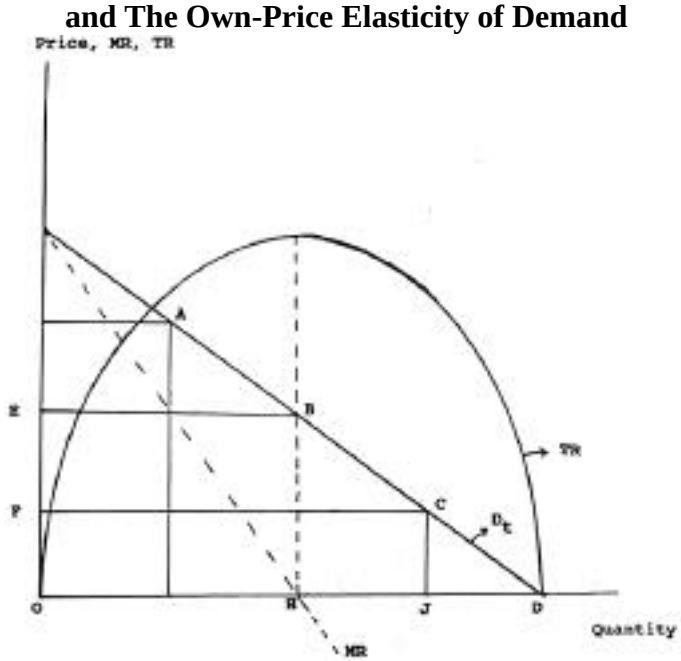


Figure 3
Price Discrimination Among ICO Quota Member Countries: United States and West Germany in the Coffee Export Market

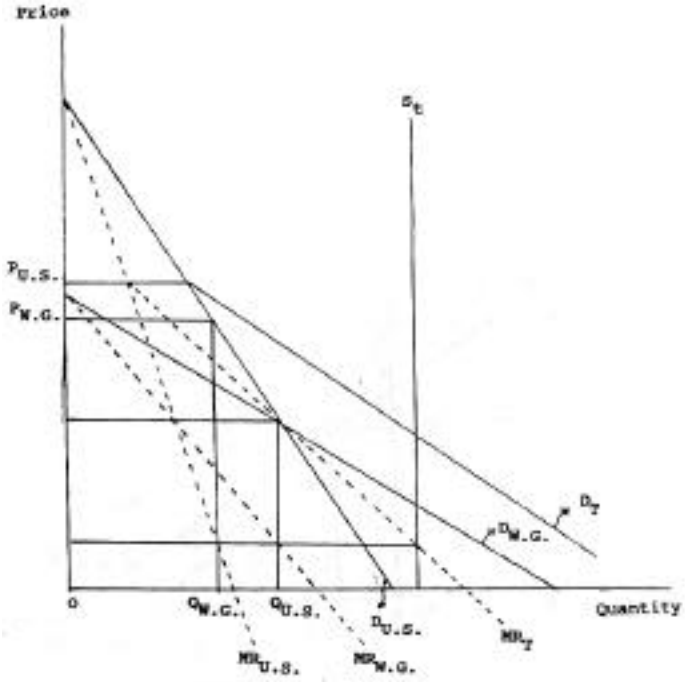
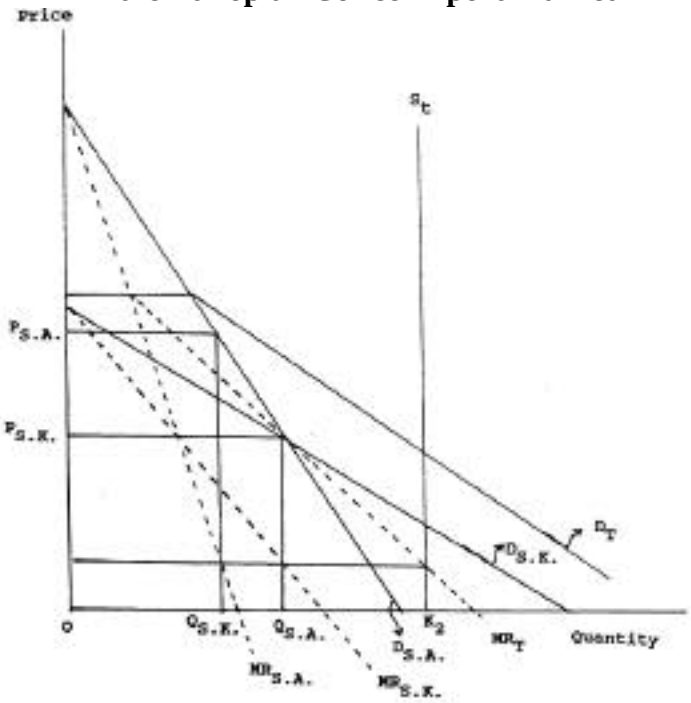


Figure 4
Price Discrimination Between Saudi Arabia and South Korea in the Ethiopian Coffee Export Market



Appendix B

A Lagrangean Algorithm for Deriving Optimum Allocations

In order to allocate the given quantity of coffee optimally among the countries in question, the langrangean multiplier (T) was utilized. To maximize total export earnings, (TEX), of the Ethiopian coffee industry, from the respective total revenue functions (TRI), the marginal revenue (MRi) from each country was equated among all countries subject to the constraint of total exportable production for a given time period. The optimum quantities which would be exported to an individual country was obtained simultaneously, and computed as follows:

30 (1.0) $TEX = TR_F + TR_I + TR_J + TR_U + TR_G + \lambda (72092.0 - CIE_1 - CIE_2 - CIE_3 -$

31 $CIE_4 - CIE_5)$.

The corresponding constrained marginal revenue functions are:

(1.1) $\partial TEX/\partial CIE1 = - 2{,}412.56 * CIE_1^{-.348} = 0$

(1.2) $\partial TEX/\partial CIE2 = - 1{,}275.61 * CIE_2^{-.268} = 0$

(1.3) $\partial TEX/\partial CIE3 = - 1{,}468.23 * CIE_3^{-.269} = 0$

(1.4) $\partial TEX/\partial CIE4 = - 85{,}277.99 * CIE_4^{-.698} = 0$

(1.5) $\partial TEX/\partial CIES = -22{,}703.84 * CIE_5^{-.270} = 0$

32 (1.6) $\partial TEX/\partial \lambda, = - CIE_1 + CIE_2 + CIE_3 + CIE_4 + CIE_5 - 72{,}909.0 = 0$

Solving for lambda in the first constrained marginal revenue function,

(2.1) $2{,}412.56 * CIE_1^{-.348} = \lambda$

and substituting the value of lambda in the corresponding constrained marginal revenue functions, using CIE1 as numeraire, yields:

(2.2) $CIE_2 = 0.093 * CIE_1^{1.299}$

(2.3) $CIE_3 = 0.158 * CIE_1^{1.294}$

(2.4) $CIE_4 = 165.3 * CIE_1^{.498}$

(2.5) $CIE_5 = 4{,}036.5 * CIE\ 1^{1.289}$

The sum of all CIE's should sum to 72,909.0, the base period production level, which in terms of the initial export function, is expressed as:

(3.0) $CIE_1 + .093 * CIE_1^{1.299} + .158 * CIE_1^{1.294} + 165.3 * CIE_1^{0.498} + 4036.5 * CIE_1^{1.289} = 72{,}909.0$

Solving for equation 3.0 was facilitated through use of a BASIC program written to generate values of the unknown variable, CIE_1:

```
 5    REM * BASIC PROGRAM TNAT GENERATES APPROXIMATE SOLUTION *
10    DIM A(100), CIE1(100)
20    FOR CIE1 = 10000 TO 10050 STEP 1
30A = CIE1 + .093*(CIE1^1.299) + .158*(CIE1^1.294) + 165.3*(CIE1^.498)+4036.5*(CIE1^1.289)
40    LPRINT A, CIE
50    NEXT CIE1
60    END
```

The above program generated various values of CIE1. However, the value of CIE1 which approximately satisfies equation (3) was 10,043.4, and this value was substituted in equations (1) to obtain the values of CIE's. The sun of CIE's was 72,909.

Appendix C

Simple Correlation Matrix for Study Variables

Country					
		LCIE	LIPR	LEX	LGDP
France	LCIE	1.000	-0.252	0.662	0.734
	LIPR		1.000	-0.052	0.167
	LEX			1.000	0.195
	LGDP				1.000
Italy		LCIE	LIPR	LGDP	
	LCIE	1.000	-0.317	0.627	
	LIPR		1.000	0.237	
	LGDP			1.000	
Japan		LCIE	LIPR	LGDP	
	LCIE	1.000	-0.376	0.505	
	LIPR		1.000	0.237	
	LGDP			1.000	
U.S.A.		LCIE	LIPC	LGDP	
	LCIE	1.000	-0.335	0.056	
	LIPC		1.000	0.715	
	LGDP			1.000	
W. Germany		LCIE	LIPC	LGDP	
	LCIE	1.000	-0.198	0.685	
	LIPC		1.000	0.673	
	LGDP			1.000	